Configuration and localization of the nipple-areola complex in men

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Abstract: The causes of bilateral absence of the nipple-areola complex in men are seldom congenital, but attributable rather to destruction as a result of trauma, or after mastectomy in female-to-male transsexuals and in male breast cancer, or after the correction of extreme bilateral gynecomastia. Such a bilateral loss becomes a major reconstructive challenge with respect to the configuration and localization of a new nipple-areola complex. Because there is very little information available in the literature, we carried out a cross-sectional study on the configuration and localization of the nipple-areola complex in men.A total of 100 healthy men aged 20 to 36 years were examined under standardized conditions. The first part of the study dealt with the configuration of the nipple-areola complex (dimensions, round or oval shape). The second part concentrated on the localization of the complex on the thoracic wall with respect to anatomic landmarks and in correlation to various parameters such as weight and height of the body, circumference of the thorax, length of sternum, and position in the intercostal space. Of the 100 subjects examined, 91 had oval and seven had a round nipple-areola complex. An asymmetry between the right and the left side was found in two cases. The mean ratio of the horizontal/vertical diameter of an oval nipple-areola complex was 27:20 mm and the mean diameter for a round nipple-areola complex was 23 mm. The center of the nipple-areola complex was in the fourth intercostal space in 75 percent and in the fifth intercostal space in 23 percent of the subjects. To localize the nipple-areola complex on the thoracic wall de novo, at least two reproducible measurements proved to be necessary, composed of a horizontal line (distance from the midsternal line to the nipple = A) and a vertical line (distance from the sternal notch to the intersection of line A, = B). The closest correlation for the horizontal distance A was given by the circumference of the thorax: A = 2.4 cm + [0.09 x circumference of thorax (cm)], (r = 0.68). The best correlation to calculate the vertical distance B was found using the distance A and the length of the sternum: B = 1.2 cm + [0.28 x length of sternum (cm)] + [0.1 x circumference of thorax (cm)], (R = 0.50). In cases of bilateral absence, we recommend creating an oval nipple-areola complex in men. The appropriate localization can be calculated by means of two simple equations derived from the circumference of the thorax and the length of the sternum.

DOI: https://doi.org/10.1097/00006534-200112000-00015

Beer, Gertrude M; Budi, Srecko; Seifert, Burkhardt; Morgenthaler, Werner; Infanger, Manfred; Meyer, Viktor E (2001). Configuration and localization of the nipple-areola complex in men. Plastic and Reconstructive Surgery, 108(7):1947-52; discussion 1953.
DOI: https://doi.org/10.1097/00006534-200112000-00015

Configuration and Localization of the Nipple-Areola Complex in Men

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In cases of bilateral absence, we recommend creating an oval nipple-areola complex in men. The appropriate localization can be calculated by means of two simple equations derived from the circumference of the thorax and the length of the sternum. (*Plast. Reconstr. Surg.* 108: 1947, 2001.)

Although many reports are available with anthropomorphic measurements concerning an ideal breast configuration and its localization on the thorax in women, information and anatomic data on the nipple-areola complex in men is scarce. In contrast to the female nipple-areola complex, loss of the male nipple-areola complex is seldom encountered, and this loss is frequently considered as only a minor problem. However, there are male patients who desire meticulous reconstruction, especially when they are young.

Unilateral congenital absence of nipple-areola complex such as in the Poland syndrome,[1,2] scalp-ear-nipple syndrome,[3] or acquired loss after trauma or tumor is not a major reconstructive problem, since the remaining nipple-areola complex serves as a guide for the configuration and localization of the new nipple-areola complex. Bilateral absence of the nipple-areola complex, however, is a bigger reconstructive challenge. Bilateral athelia with or without amastia is a very rare congenital defect. The first reported case dates back to 1882, and up to now only eight additional cases have been described.[4] More often, bilateral loss of the nipple-areola complex is encountered following trauma, especially burn

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Presented at the 2nd European Appointed 35th National Congress of the Swiss Society of Plastic Surgery, in St. Gallen, Switzerland, September 2 through 4, 1999.

injury.[5] The desire for bilateral reconstruction of the nipple-areola complex is also increasing in other areas: female-to-male transsexuals, patients with extreme gynecomastia,[6–10] and other cases of previous bilateral mastectomy.

The proper configuration and localization of the nipple-areola complex requires both meticulous planning and a thorough understanding of the male anatomy. There is a common tendency to create areolas that are too large and to place the nipple-areola complex too high and too far medially.[7]

The following cross-sectional study was conducted to gain statistically relevant information on the following parameters: (1) the configuration and size of the nipple-areola complex and (2) the localization of the nipple-areola complex on the thorax. The aim of this study was to create a reliable, individualized protocol that takes into account the various relevant anatomic features of the patients and can be applied directly to the clinical setting by the reconstructive surgeon.

Patients and Methods

A total of 100 healthy young Caucasian male volunteers aged 20 to 36 years were examined according to a standardized protocol by a single examiner. They were asked for weight and height. Subjects who had previous breast surgery, hormone therapy, inverted nipples, gynecomastia, or malformations on the thoracic cage such as scoliosis were excluded from the study.

The measurements were carried out using an anthropometric caliper (Messtechnik Kern, Forchtenberg, Germany) (0 to 150 ± 0.005 mm) and a measuring tape for distances larger than 15 cm. During the measurements, the young men were dressed from the waist down. They were standing in a fully upright position, with the arms at their sides. All subjects were in a warm room with a temperature of about 22°C to prevent a possible cold-induced nipple-areola contraction.

Measurements to the nipple were made to the center of the nipple. Measurements to the umbilicus were made to the center of the umbilicus, and measurements to or from anatomic landmarks such as the sternal notch, anterosuperior iliac spine, or acromioclavicular joint were made to the superior (sternal notch) or superolateral border of each (anterosuperior iliac spine, acromioclavicular joint). All these landmarks were marked with a medical pen before measuring. The names and abbreviations for the anatomic landmarks were chosen according to the terminology of Westreich,[11] who carried out similar anthropomorphic breast measurements in women. The first part of the measurements dealt with the configuration of the nipple-areola complex.

- Horizontal diameter of the complex.
- Vertical diameter of the complex.
- Configuration of the complex, whether round or oval. If oval, the complex was classified according to its longer diameter as horizontal-oval, vertical-oval, or oblique-oval (either sternal notch <−−> anterior iliac spine or acromioclavular joint <−−> umbilicus).
- Diameter of the nipple (assuming the nipples were round).
- Height of nipple above surrounding areola.

The second part of the study concentrated on the location of the nipple-areola complex on the thoracic wall with respect to fixed skeletal points and in correlation to various measurements (Fig. 1).

- Distance between the sternal notch-manubrium (M) and nipples (N).
- Horizontal distance between midsternal line (S) and nipples (N) = A.
- Length of the sternum [i.e., distance between sternal notch (M) and the tip of xiphoid (X)].
- Circumference of the thorax at the height of the complex.
- Position of the nipple in the intercostal space.
- Position of the nipple with respect to a line from the acromioclavicular joint (AC) to the umbilicus (U).
- Position of the nipple with respect to a line from the sternal notch (M) to the anterosuperior iliac spine (AS).

The position of the nipple with respect to the often used midclavicular line was not entered in the protocol because of the existing diversity as to the starting point of the midclavicular line.

Statistical analysis was performed using StatView 5.0.1. (SAS Institute, Inc., Cary, N.C.) and SPSS 6.1 (SPSS, Inc., Chicago, Ill.). Nominal variables were presented as n (percent). Continuous variables were summarized as mean ± SD. Predictors for the horizontal (A) and ver-

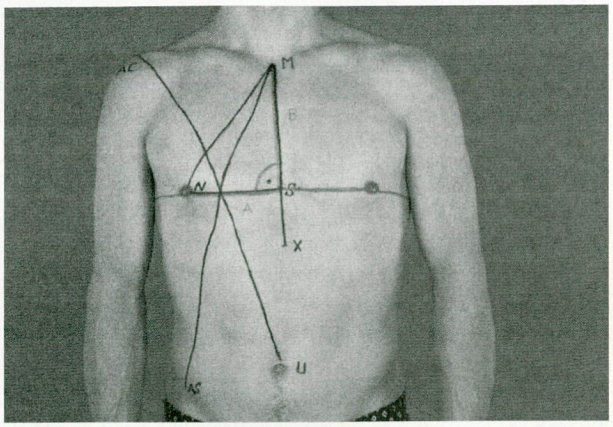

FIG. 1. Anatomic landmarks and possible lines for the localization of the nipple-areola complex on the thoracic wall. *M*, manubrium, sternal notch; *N*, nipple; *S*, midline of sternum; *X*, xiphoid; *U*, umbilicus; *AC*, acromioclavicular joint; *AS*, anterosuperior iliac spine; *horizontal line*, circumference of the thorax; *lines A and line B*, for determining the nipple-areola complex localization in case it is missing (the two lines are perpendicular to each other).

tical distance (B) of nipples from and along the midsternal line, respectively, were determined using univariate and stepwise linear regression analysis. B was computed as the square root of (distance M-N)^2-X^2. Predictors for the localization of nipples in the intercostal space were determined using stepwise logistic regression, and p values ≤ 0.05 were considered significant.

RESULTS

The average age of the 100 subjects included in the study was 27 years. The range of 20 to 36 years was determined in advance, as no major biologic alterations are expected within this time span.

Since the objective of the study was to gain information on as wide a range of body builds as possible, no cut-off values were given for height or weight of the subjects. Indeed, the subjects encompassed the wide ranges of height and weight (height, 165 to 195 cm; weight, 59 to 110 kg) that are found within the normal population. Further details are listed in Table I.

TABLE I
Demographic Data and Measurements of the 100 Subjects

Parameter	Mean ± SD	Range
Age (years)	26.7 ± 4.5	20–36
Height (cm)	179.3 ± 6.9	165–195
Weight (kg)	76.8 ± 9.5	59–110
BMI	23.9 ± 2.9	17.6–34.2

Measurements on the configuration of the nipple-areola complex revealed that 91 percent of the complexes were oval and only 7 percent were round (Fig. 2). The complexes were asymmetric in 2 percent of cases; both times one nipple-areola complex was round and the other was oval. Of the round complexes, the mean diameter (Ø) was 23 mm. The oval nipple-areola complex had a mean horizontal Ø of 27 mm and a mean vertical Ø of 20 mm. The axis of the longer (horizontal) Ø was exactly horizontal only twice; in all others cases it was slightly oblique, perpendicular to the fibers of the pectoralis major muscle. The mean Ø of the nipple itself was 7 mm, with a height of 3 mm. The standard deviations and ranges of these nipple-areola complex measurements are listed in Table II.

Describing the localization of the nipple-areola complex on the thorax by various measurements, the average distance from sternal notch to nipple was 20 cm. The average horizontal distance from the midsternal line to the nipple was 11 cm and the average distance from the sternal notch to the xiphoid was 20

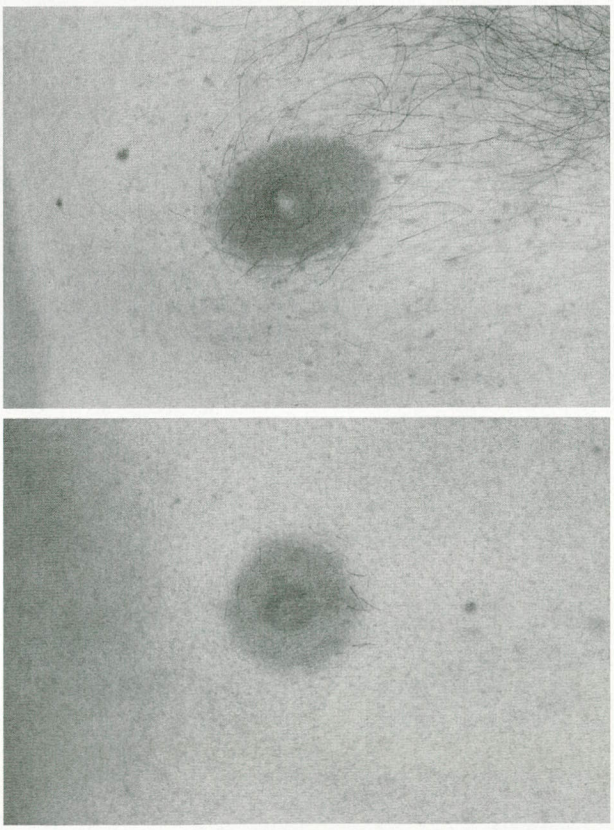

FIG. 2. Example of an oval nipple-areola complex (perpendicular to the fibers of the pectoralis major muscle) (*above*) and a round nipple-areola complex (*below*).

TABLE II
Nipple-Areola Complex Measurements in Millimeters (n = 200)

Parameter	Mean ± SD	Range
Diameter of NAC (round) (n = 16)	23.1 ± 3.1	18–29
Horizontal diameter of NAC (oval) (n = 184)	26.9 ± 4.8	18–46
Vertical diameter of NAC (oval) (n = 184)	19.3 ± 3.8	12–35
Diameter of nipple (n = 200)	6.9 ± 1.4	4–11
Height of nipple (n = 200)	2.7 ± 1.1	1–9

NAC, nipple-areola complex.

cm. The mean circumference of the thorax was 97 cm, with a range from 83 to 120 cm.

Regarding the localization of nipples in the intercostal space, 75 percent were found in the fourth intercostal space and 23 percent in the fifth intercostal space. One individual had the nipples located in the sixth intercostal space (the subject was 175 cm, i.e., not the tallest subject in our collective) and one individual had the nipples placed asymmetrically, one in the third and one in the fourth intercostal space. The stepwise logistic regression showed that the probability of the nipples lying in the fifth intercostal space was independently correlated to a high body mass index (odds ratio, 1.5 per kg/m^2, p = 0.0002) and to the distance M-X (odds ratio, 1.05 per cm, p = 0.0075), but that the nipple was always located in the fourth or the fifth intercostal space, irrespective of the height of the subject. Additional data concerning measurements for the localization of the nipple-areola complex are found in Table III.

The measurements showed no significant differences between the right and left side. The distances AC-U and M-AS were not included into the final statistical analysis, as the measurements were too variable between both sides and gave no relevant correlations. For the placement of the nipple-areola complex on the thoracic wall de novo, at least two reproducible measurements, a horizontal distance (A) and a vertical line (distance B) were necessary (Fig. 1).

The stepwise regression analysis with age, weight, height, body mass index, M-X, and circumference of the thorax showed that the circumference of the thorax was the only independent predictor (r = 0.68) for the horizontal distance between the midsternal line (S) and nipples (N). The appropriate formula for calculating the distance A is as follows:

A = 2.4 cm + [0.09 × circumference of thorax (cm)].

To define the vertical distance, the closest correlation was found between the distance A and the length of the sternum (R = 0.50). Thus, the vertical distance B is calculated as follows:

B = 1.2 cm + [0.28 × length of sternum (cm)] + [0.1 × circumference of thorax (cm)].

TABLE III
Distances from and Measurements of Anatomic Landmarks in Centimeters

Parameter	Mean ± SD	Range
Distance M-N (n = 200)	20.0 ± 1.5	16–24
Distance S-N (n = 200) = A	11.2 ± 0.9	9–14
Distance M-X (n = 100)	20.0 ± 1.7	17–27
Circumference of thorax (n = 100)	96.7 ± 7.1	83–120

Discussion

With this study we were able to show that with two easily measurable distances, the circumference of the thorax and the length of the sternum, the optimum location of any new nipple-areola complex can be defined. Using the mathematical formulae, it would even be possible to create a computer-generated reference table of appropriate nipple-areola complex positions for every circumference of the thorax and every length of the sternum in centimeter steps within the statistical ranges.

For the sake of precision, we used only easily measurable distances on the thorax. We avoided soft-tissue landmarks[12] such as the midhumeral point, unreliable distances (midclavicular line), and distant landmarks such as the anterosuperior iliac spine or the elbow. The main reason for this decision was the knowledge about the different body proportions in human beings who have long limbs and a short thoracic cage or vice versa.[13] In a similar publication about anatomic parameters for nipple-areola complex position in men, Beckenstein et al.[14] measured three distances: from sternal notch to nipple, from midclavicular line to nipple, and the nipple-to-nipple distance. Whereas their measurements concerning the average distance from sternal notch to nipple were completely in accordance with our results (average distance, 20 cm), we found no statistically significant correlation to the body height for an equation to determine the nipple-areola complex position as he did. In our study, we found that the correlation coefficient for height, M-N, was r = 0.14 with a p value of

0.17, which is not significant. At first glance, it might be surprising that the body height is not a determining factor for the anterosuperior iliac spine localization, but if one considers the various types of body build, this fact is easily explainable. The same applies to the weight of the body, as the amount of fat and muscle is localized according to a variety of different genetic and alimentary patterns.

Other publications rely on the various different anatomic and soft-tissue landmarks from the acromioclavicular joint to the anterosuperior iliac spine to the pubis; we avoided these, as they are too difficult to standardize. One of these authors locates the nipple of young male and female subjects approximately at the superior quarter point of body height on a line passing from the pubis to the acromioclavicular joint.[15] Peck[13] suggested that the nipples should be projected in a perpendicular line with the anterosuperior iliac spine and the medial corner of the infraclavicular fossa and should be separated by at least one head length. Lindsay[7] located the nipple over the fifth rib and 10 to 11 cm from the midline and 2.5 cm medial to the lateral border of the pectoralis major. He also suggested, as less accurate horizontal and vertical landmarks, the midclavicular line and the site opposite the middle of the humerus. A similar idea, but for female subjects, was published by Maliniac.[16] He defined the ideal nipple plane as a line level to the midpoint on the shaft of the humerus, or 1.5 cm below the midhumeral point; altogether, these represent a variety of measurements that we would not recommend.

Our results concerning the localization of the nipple with respect to the intercostal space showed that most of them were located in the fourth or the fifth intercostal space. In the case of mastectomy in female-to-male transsexuals, Hage and van Kesteren,[8] too, claimed that care has to be taken to plan the future nipple position of the nipple-areola complex on a line going straight upward from the native site of the nipple at the crossing of the fourth or the fifth rib over the inferior margin of the pectoralis muscle. In the case of an absent nipple-areola complex, the circumference of the thorax should therefore be measured at the height of the fifth rib.

Concerning the configuration of the nipple-areola complex, the overwhelming majority of them were oval. The configuration seems to be influenced by the developmental state of the major pectoral muscle. We initially had the impression that in those subjects with a pronounced pectoral major muscle the nipple-areola complex was oval, whereas in men with a less developed pectoral muscle the nipple-areola complex was round. However, a 7 percent incidence of round nipple-areola complex was too small a number to prove this assumption.

Addressing the average diameter of nipple-areola complex, Beckenstein et al.[14] found it to be 28 mm in a North American population, and Trier,[4] reporting measurements in 62 male subjects, indicated the same average. Our findings in a European population showed a slightly smaller nipple-areola complex, with a mean diameter of 23 mm for round complexes and 27:20 mm for an oval complex. Nevertheless, the range of all diameters (Table I) is so wide that it can be considered a matter of taste how big to create a nipple-areola complex. It is preferable to obtain the informed consent of the patient about the planned nipple-areola complex dimensions.

In conclusion, the male nipple-areola complex is usually oval. By means of two simple measurements (the circumference of the thorax and the length of the sternum) and two simple equations, the appropriate localization of the nipple-areola complex on a male chest can be calculated before reconstructive surgery.

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ACKNOWLEDGMENTS

The authors are grateful to the Swiss Armed Forces and to Doctors K. Belouli and S. Suessmuth for their cooperation and assistance in recruiting the volunteers.

REFERENCES

1. Poland, A. Deficiency of the pectoral muscles. *Guy's Hosp. Rep.* 6: 191, 1841.
2. Beer, G. M., Kompatscher, P., and Hergan, K. Poland's syndrome and vascular malformations. *Br. J. Plast. Surg.* 49: 482, 1996.
3. Edwards, M. J., McDonald, D., Moore, P., and Rae, J. Scalp-ear-nipple syndrome: Additional manifestations. *Am. J. Med. Genet.* 50: 247, 1994.
4. Trier, W. C. Complete breast absence: Case report and review of the literature. *Plast. Reconstr. Surg.* 36: 431, 1965.

5. Spence, R. J. Bilateral reconstruction of the male nipple. *Ann. Plast. Surg.* 28: 288, 1992.
6. Hoopes, J. E. Surgical construction of the male external genitalia. *Clin. Plast. Surg.* 1: 325, 1974.
7. Lindsay, W. R. N. Creation of a male chest in female transsexuals. *Ann. Plast. Surg.* 3: 39, 1979.
8. Hage, J. J., and van Kesteren, P. J. M. Chest-wall contouring in female-to-male transsexuals: Basic consideration and review of the literature. *Plast. Reconstr. Surg.* 96: 386, 1995.
9. Hage, J. J., and Bloem, J. J. A. M. Chest wall contouring for female-to-male transsexuals: Amsterdam experience. *Ann. Plast. Surg.* 34: 59, 1995.
10. Kornstein, A. N., and Cinelli, P. B. Inferior pedicle reconstruction technique for larger forms of gynecomastia. *Aesthetic Plast. Surg.* 16: 331, 1992.
11. Westreich, M. Anthropomorphic breast measurement: Protocol and results in 50 women with aesthetically perfect breasts and clinical application. *Plast. Reconstr. Surg.* 100: 468, 1997.
12. Smith, D. J., Jr., Palin, W. E., Jr., Katch, V. L., and Bennett, J. E. Breast volume and anthropomorphic measurements: Normal values. *Plast. Reconstr. Surg.* 78: 331, 1986.
13. Peck, S. R. *Atlas of Human Anatomy for the Artist.* Oxford, England: Oxford University Press, 1951.
14. Beckenstein, M. S., Windle, B. H., and Stroup, R. T., Jr. Anatomical parameters for nipple position and areolar diameter in males. *Ann. Plast. Surg.* 36: 33, 1996.
15. Broadbent, T. R., and Mathews, V. L. Artistic relationships in surface anatomy of the face: Application to reconstructive surgery. *Plast. Reconstr. Surg.* 20: 1, 1957.
16. Maliniac, J. W. *Breast Deformities and their Repair.* New York: Grune & Stratton, 1950. P. 68.